2017

Paper Mill Run Riparian Zone Management Plan and Partial Restoration

Kevin Brown

An independent study project report by The Walter W. Root Endowed Arboriculture Intern (2016-2017)

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Abstract
The natural area at the Morris Arboretum is a quickly developing section of the garden. However, it has many unappreciated views and rarely visited areas that deserve more recognition. Unfortunately, it also has some neglected and under-developed areas that need revitalization. One such area is the riparian zone along the east bank of Paper Mill Run, beginning just after the *Betula nigra* HERITAGE grove planted between the wetland and Paper Mill Run, and continuing to where Paper Mill Run meets the Wissahickon Creek. This area was assessed, and the existing trees were documented considering tree health, size, importance, and work recommendations. This information was used to create a management plan designed to gradually improve the area over the coming years in terms of riparian buffer functionality as well as public appeal.

The goal of this project was to define what a riparian buffer is and what it does; assess the riparian zone along Paper Mill Run on the property of the Morris Arboretum; design a long term management plan for the existing plants and for future plantings; and begin to restore one pre-determined section of the zone. A literature review of peer-reviewed journals was referenced to gain informed knowledge on what a healthy riparian zone is, and what it should do for the stream; direct evaluation of the zone along Paper Mill Run was carried out; management plan recommendations were developed to maintain and improve the area over time; and appropriate action to begin to restore part of the zone was accomplished.

Disciplines
Horticulture

Comments
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DATE: **March 2017**

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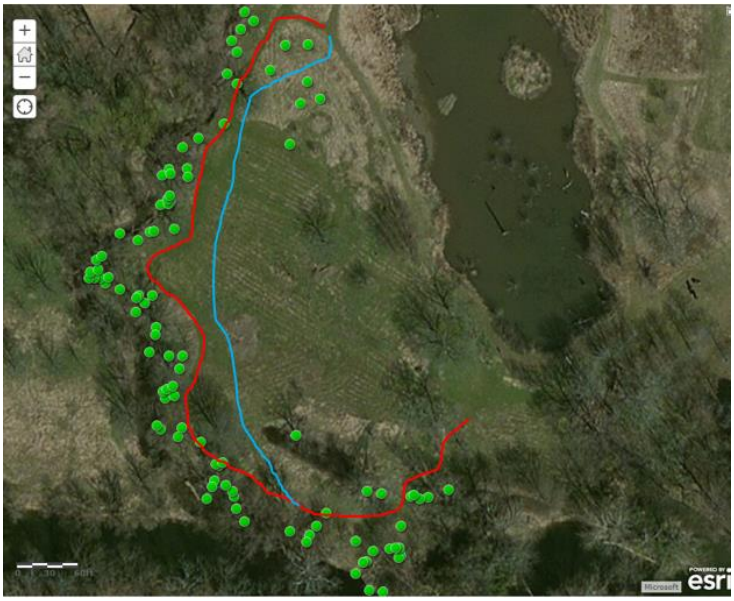

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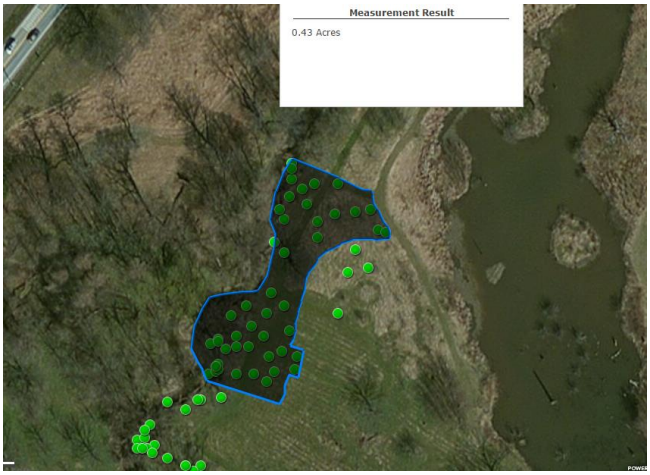

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INTRODUCTION

The Natural Areas at the Morris Arboretum offer some very interesting educational opportunities, as well as access to some less traveled, more secluded sections of the garden to which one can retreat. When compared to the more meticulously maintained, more aesthetically focused, more heavily visited gardens of the Arboretum, the Natural Areas offer a refreshing getaway to the more wild aspect of plants in natural settings. Unfortunately, however, much of this area is largely untraveled by most visitors, and is even lacking in general maintenance, thus detracting from its overall purpose. This area should be used to demonstrate native plants in their natural setting. It should show what a healthy, natural ecosystem in the Pennsylvania piedmont looks like. Some areas of the Natural Lands at the Morris Arboretum lack this healthy, native aspect, and are lacking in overall species diversity. The riparian zone on the eastern bank of Paper Mill Run is one such area.

Riparian zones are areas of land that border bodies of water. They can vary in size and content, but they all accomplish similar goals – to clean, stabilize, and maintain both the quality of water entering the water body and the water body itself. They play many different roles in maintaining proper ecosystem functions for every living thing around them, from aquatic life, to terrestrial and avian life, to soil life, which all aid in the quality of the stream ecosystem. When restoring a riparian zone, the general benchmark that is followed is that of an undisturbed forested area surrounding a native body of water (Welsch, 1992). This area is ideally undisturbed in terms of human development and is devoid of invasive species (Welsch, 1992). In addition, the wildlife value of birds is prized at the Arboretum. Reforesting this area will attract a larger diversity of birds, thus adding to the area's overall value.

It is important to include not only a diversity of woody plant species in a riparian zone, but a large diversity of non-woody plants as well. This way, they can work together to trap as much water as possible, and help fill any unknown ecological niches. Hawes and Smith (2005) outline this teamwork by saying, "Grasses have a shallower and denser root mat that is more effective in slowing runoff and trapping sediments from the surface flow. Trees have a deeper root system that can trap and uptake nutrients from the groundwater, stabilize banks, and regulate the flow of water to the stream." (Hawes and Smith, 2005).

MANAGEMENT PLAN/GOALS

The primary goal of this project was to develop a long term arboricultural management plan to restore the riparian zone starting at the existing *Betula nigra* HERITAGE grove and continuing to the Wissahickon Creek. The secondary goal was to put this plan into action in a small piece of that larger section. To develop a management plan, every existing tree in the area was mapped, evaluated, and documented to get an idea of what was already there, what should be changed about the existing state, and what new things should be added. Evaluation would include a documentation of tree species identification, tree location, tree size (Circumference at Breast Height [CBH], height, and spread), tree health/life expectancy (Dead, <5 years, 5-15 years, >15 years), and arboricultural work recommendations based on these observations. Recommendations would include hazard pruning, structural pruning, removal, clearance pruning, vine removal, and other tree health and/or hazard recommendations as seen fit. These recommendations were assigned a priority value based mainly on immediate needs according to safety hazards and preservation of the natural conditions in the area. They were not treated the same as they would be in the formal garden. It was recognized that this is the Natural Area, and as such, the trees should reflect how they would be found in nature, with the exception of safety hazards.

METHODS/WORK COMPLETED

An area of high concern was determined to be the active project area, on the east side of Paper Mill Run, stretching from the *Betula nigra* HERITAGE grove to the Wissahickon Creek (see Figure 1). This area was surveyed using ArcGIS Collector™ to document the following information of existing trees in the area with a CBH greater than six inches:

ID Number: Trees of 6" CBH and greater were previously tagged and assigned an ID number indicated on a silver tag nailed to the trunk of the tree by past interns and/or horticulturists.

Location: The spatial location of each individual tree in the area was marked on the interactive ArcGIS Collector™ map.

Common Name: The common name of the tree was recorded.

Species: Genus and specific epithet were recorded. A specific epithet of "spp." was used for trees whose actual specific epithet could not be determined.

Circumference at Breast Height (CBH): Trunk circumference at approximately 4 feet, measured in inches, was recorded. Up to five CBH's were measured for multi-stemmed trees. For trees that could not be measured at breast height, "measured-at" height was recorded.

Spread: Measure of the spread of the canopy, in feet.

Height: Estimated using objects of known height, in feet.

Life expectancy: Based on physical, observable conditions, given a value of "Less than 5 years", "Between 5 – 15 years", and "Greater than 15 years".

Comments: General comments were made regarding work or special interest, such as pruning/removal recommendations or areas that may be of notable public interest.
Images: Images were uploaded to the interactive map of particularly interesting trees. Images were also taken of ideal areas for bench locations.

The existing truck path in the entire area, which was very close to the stream bank and existing riparian trees, was also relocated. It was moved further out into the meadow, away from the bank (see Figure 2). The purpose of this was to reduce erosion and soil compaction along the stream bank, as well as to create more space for future plantings in the entire area. In the fall of 2016, the pre-existing truck path was closed off to all vehicular traffic, and a new truck path was mowed into the meadow, approximately 15 feet farther away from the stream bank than the original path.

A smaller section at the beginning of this riparian zone was designated as the active project area where riparian restoration would begin (see Figure 3). The active work area was mapped out using the ArcGIS Collector™ online function, in which one can use aerial images and GPS coordinates to map an area in square feet (see Figure 4). This information was used to order an appropriate amount of native grass seed mix to be planted in the work area. This grass seed mix would be seeded in the fall of 2017 following an application of aquatic-safe herbicide to kill any existing herbaceous plants. This would rid the area of invasive herbaceous grasses and forbs and reduce competition for the native seed mix.

In November of 2016, active restoration began. Redundant and invasive species, both woody and herbaceous, were either removed or mowed to the ground. This opened up the area greatly so that planning for the planting of new species could begin. Herbaceous plants were cut to the ground, and woody plants were cut to a stump of about five inches in height. This allowed the stumps to be cut again in the future so that herbicide could be painted on a freshly cut stump to discourage re-sprouting.

The following month, December of 2016, the area was intentionally analyzed, and an informal planting plan was developed. Only species found on the "Wetland Plants" list developed by Arboretum botanists Tim Block and Ann Rhoads in 2001 were used. This list

consisted of native plants, both woody and herbaceous, that have been observed in similar wetland areas in similar geologic regions elsewhere in Pennsylvania. Species were also selected based on their wildlife and ecological value, seasonal aesthetic interest, and according to themes found elsewhere in the wetland area of the Arboretum. This plan outlined which species of trees would actually be planted, determined where each individual tree would be planted, and how many plants would be planted. This included canopy trees, understory trees, and shrubs. Flags indicating tree species were placed in the ground in the location of where that specific tree would be planted. In January of 2017 and again in February of 2017, this plan was slightly modified and confirmed by Anthony Aiello, the Morris Arboretum Director of Horticulture and Curator. The following list of plants shows what species were chosen, why they were chosen, and how many are recommended for the initial planting:

Canopy trees:

- *Ulmus Americana* 'Princeton', American Elm 'Princeton': Chosen for its ability to adapt to wet sites, food production for birds, interesting/appealing growth habit, resistance to Dutch Elm Disease of 'Princeton', and because it echoes *Ulmus americana* 'Valley Forge' found elsewhere in the wetland area. Planting three.
- *Carya ovata*, Shagbark Hickory: Chosen for its ability to adapt to wet sites; wildlife value of the nuts; interesting, shaggy bark; interesting, irregular growth habit; habitat value for migrating bats, which seek shelter under its bark; and bright fall color. Planting two.
- *Quercus bicolor*, Swamp White Oak: Chosen for its ability to tolerate wet sites, wildlife value of acorns, interesting fall color, and because it complements other *Quercus* found in the wetland area. Planting one.
- *Acer saccharinum*, Silver Maple: Chosen for its ability to thrive in wet sites; its ability to grow quickly and stabilize stream banks; the wildlife value of its seeds; and to replace existing, mature *Acer saccharinum's* in the area. Planting multiple tubes.

Understory trees:

- *Carpinus caroliniana*, American Hornbeam: Chosen for its ability to tolerate clay soils and wet areas; its interesting growth habit; its attractive, aesthetically pleasing bark; wildlife value of its seeds , especially to birds; to complement *Carpinus* found elsewhere in the wetland area; and for its attractive fall color. Planting four.
- *Chionanthus virginicus*, Fringe Tree: Chosen for ability to thrive in wet areas; its fragrant, aesthetically appealing flowers; its value to pollinators; the wildlife value of its fruit, especially to birds; and its fall color. Planting three.
- *Betula nigra*, River Birch: Chosen for its ability to thrive in wet areas; its reddish-orange, exfoliating bark; its fast growth; the wildlife value of its seeds, particularly for birds including ruffed grouse and wild turkey. Planting eleven.
- *Malus coronaria*, Sweet Crabapple: Chosen for its ability to tolerate lowland areas, particularly forest edges (it will be planted on the outer edge of the planting area); the value of its flowers to pollinators; the aesthetic appeal of its flowers; the wildlife value of its fruit; and its interesting growth habit. Planting three.
- *Cornus florida* 'Appalachian Spring', Flowering Dogwood 'Appalachian Spring': Chosen to be used as a trial to see how it does in a wetter, lowland area; for the anthracnose resistance of 'Appalachian Spring'; the aesthetic appeal and pollinator value of its flowers; and the wildlife value of its fruit, especially to birds. Planting one.

Shrubs:

- *Ilex verticillata*, Winterberry Holly*:* Chosen for its ability to thrive in wet areas; the wildlife value of its berries; the aesthetically appealing red berries in the winter; and to echo other *Ilex verticillata* found in the wetland area. Planting ten.
- *Cornus amomum*, Silky Dogwood*:* Chosen for its ability to tolerate wet areas; the pollinator value of its flowers; the aesthetic appeal of its flowers; its ability to tolerate juglone released by walnut trees; its interesting reddish bark on young growth; and to complement other *Cornus amomum* found in the wetland area. Planting ten.
- *Physocarpus opulifolius*, Ninebark*:* Chosen for its ability to tolerate wet sites; the pollinator value of its flowers; the aesthetic appeal of its flowers; the wildlife value of its fruit; and its attractive, exfoliating bark, which is particularly interesting in the winter. Planting >ten.
- *Myrica pennsylvanica*, Northern Bayberry*:* Chosen for its ability to thrive in wet soils; its aromatically pleasing leaves; its pollinator value; its whitish fruits that persist through the winter; and the wildlife value of its fruits. Planting five.
- *Lindera benzoin*, Spicebush*:* Chosen for its ability to tolerate wet areas, its aromatic flowers, the pollinator value of its flowers, the wildlife value of its fruit, its ability to provide visual screening, and its attractive fall color. Planting four.

To add to the overall aesthetic appeal and interest of the area, it is recommended that *Taxodium distichum*, Bald Cypress, be planted after re-grading work is completed along the stream bank. These trees do well in very wet sites, and will help to hold the bank together after it is re-graded. They will also greatly enhance the aesthetic interest of the area. They should be planted along the bank in such a way that it seems they are "creeping" across the stream, since they are already found on the other side of the stream. The exact number and locations can be determined by the natural areas horticulturist and curator when the time comes.

The databases of several nurseries were searched for available species and prices for each of the trees. These nurseries included the following: Natural Landscapes Nursery in West Grove, PA; Octoraro Native Plant Nursery in Kirkwood, PA; Sylva Native Nursery in Glen Rock, PA; Pleasant Run Nursery in Allentown, NJ; Pinelands Nursery and Supply in Columbus, NJ; and Ernst Conservation Seeds Incorporated in Meadville, PA for the grass seed mix. The information gathered from these databases was recorded and compared to ensure the best prices and plant quality were chosen. In addition to these public nurseries, the greenhouse inventory at the Morris Arboretum was searched for relevant plants to be used to mitigate cost. The plants available from the greenhouse were documented first, and anything not available was purchased from the public nurseries.

The Natural Resources Conservation Service (NRCS) in Vermont says that the goal of any woody tree planting should be to plant so that natural ecological succession can take place over time. (United States, USDA, VT NRCS, n.d.). With this in mind, enough space was left in the planting area to allow the existing plants to seed-in. This would help promote the success of native plants, as well as offset the monetary cost of planting by lowering the number of plants purchased.

To enhance the public appeal of the area, a bench was built at the end of the planting area, and its location is indicated on the ArcGIS Collector™ map (See Figure 5). This bench

was built using rot resistant *Robinia pseudoacacia* (Black Locust) wood from a tree that was cut down from the property of the Morris Arboretum about five years ago. The wood was milled using a chain saw mill, and was stored in the Bloomfield Farm barn. This board was mounted to two legs made of Black Locust logs standing upright. These logs were buried one foot at the base to aid in stabilization, and were made to look like tree stumps in the ground. In the middle of these legs, a four foot long rod was drilled into the ground. This rod had a disc on the bottom to anchor it in the ground, and an eye on the top end to be used to anchor the bench. To anchor the bench to the ground, tree support cable was passed through this eye and anchored to both of the legs of the bench using lag hooks, as demonstrated on pages 138 – 140 under the "Cabling Installation Techniques" section in chapter nine of the Arborists' Certification Study Guide 2010 version (Lilly, S. J., 2010). This serves not only to anchor the bench in the case of a flood, but also to demonstrate tree support systems used by arborists.

SURVEY RESULTS/RECOMMENDATIONS

A total of 99 pre-existing trees were recorded. Only trees with a CBH of six inches or greater were recorded, unless it had already been accessioned or tagged.

Priority levels were rated one through three, with one being the most urgent, and three being less urgent. A priority level of one was reserved for potential hazards, while a priority level of two was used for invasive species that needed to be removed, and a priority level of three was used for anything else. For example, structural pruning, thinning out, pruning deadwood and small hangers with a small chance of hitting a target, or trees that should be removed to make room for other trees were all assigned a priority level of three. The reason for this was because this is the natural area, and bad form or "unsightly" features are not of great concern, unless they present a safety hazard to guests. Of the ninety-nine trees in the area, only sixty-five were assigned recommendations. The remaining thirty-four needed no attention.

Priority 1:

- Id number 1255, *Fraxinus pennsylvanica*. End weight reduction over path.
- Id number 2584, *Acer negundo*. End weight reduction where beam cracks are present.
- Id number 79, *Juglans nigra.* Reduce end weight to mitigate potential hazards. Tree is dead, but away from path.
- Id number 2434, *Acer negundo.* Reduce end weight and remove hangers.
- Id number 60, *Acer saccharinum.* Remove dead leaders, end weight reduction.
- Id number 59, *Juglans nigra.* Eliminate hangers.
- Id number 53, *Acer saccharinum.* Reduce dying leaders, prune deadwood.
- Id number 52, *Acer saccharinum.* Reduce/remove dying/dead leaders, prune deadwood.
- Id number 51, *Acer saccharinum.* Reduce/remove dying/dead leaders, prune deadwood.
- Id number 48, *Acer negundo.* Prune deadwood.
- Id number 2436, *Juglans nigra.* Eliminate hangers.
- Id number 47, *Juglans nigra.* Prune deadwood and eliminate hangers.

Priority 2:

- Id number 2449, *Acer negundo.* Remove invasive honeysuckle at base.

- Id number 95, *Phellodendron spp.* Remove invasive.
- Id number 2444, *Paulownia tomentosa*, Remove invasive.
- Id number 67, *Acer saccharinum.* Remove invasive shrub at base.
- Id number 65, *Acer negundo.* Remove invasive honeysuckle at base.

Priority 3:

- Id number 2582, *Acer negundo*. Replace overgrown tag.
- Id number 2578, *Carya spp.* Remove deadwood and encourage one leader.
- Id number 2579, *Carya spp.* Encourage one leader.
- Id number 2583, *Fraxinus pennsylvanica.* Prune deadwood.
- Id number 2586, *Catalpa speciose.* Remove 2 leaders that are shading out planetree.
- Id number 2587, *Fraxinus pennsylvanica.* Prune deadwood.
- Id number 2589, *Acer negundo*. End weight reduction over path.
- Id number 1498, *Juglans nigra.* Structural pruning.
- Id number not located (On bank near 2449, *Acer negundo*), *Platanus Americana.* Replace tag, clear honeysuckle and saplings at base of tree and remove vines to create a view. Very large, mature, stately tree.
- Id number 92, *Acer negundo*. Structural pruning.
- Id number 89, *Acer negundo.* Structural pruning.
- Accession number 2006-087-A, *Gleditsia aquatic.* Deadwood and hanger pruning.
- Id number 88, *Acer negundo.* Reduce leaders.
- Id number 87, *Catalpa speciosa.* Prune deadwood.
- Id number 84, *Catalpa speciosa*. Structural pruning for one leader, prune deadwood, eliminate rubbing with 85.
- Id number 2441, *Acer negundo.* Remove to make room for catalpa.
- Id number 2440, *Acer negundo.* Structural pruning.
- Id number 2443, *Fraxinus pennsylvanica.* Remove Boxelder saplings growing at base, prune deadwood.
- Id number 2438, *Catalpa speciosa.* Structural pruning.
- Id number 2590, *Acer negundo.* Structural pruning.
- Id number 76, *Acer negundo.* Remove boxelder saplings at base and remove dead leader.
- Id number 71, *Acer negundo.* Prune deadwood.
- Id number 70, *Acer negundo.* Structural pruning.
- Id number 68, *Acer saccharinum.* Prune deadwood and reduce end weight.
- Id number 65, *Acer negundo.* Structural pruning; remove honeysuckle at base (Priority 2).
- Id number 63, *Carya spp.* Structural pruning.
- Id number 61, *Juglans nigra.* Structural pruning. (Tree marks the end of active restoration zone).
- Id number 59, *Juglans nigra.* Structural pruning.
- Id number 56, *Acer negundo.* Structural pruning.
- Id number 54, *Juglans nigra.* Structural pruning.

- Id number 2437, *Juglans nigra.* Structural pruning.
- Id number 48, *Acer negundo.* Prune off catalpa (2674).
- Id number 2674, *Catalpa speciosa.* Structural pruning.
- Accession number 2016-062-B, *Quercus palustris.* Structural pruning.
- Accession number 2011-019-A, *Quercus bicolor.* Structural pruning.
- Id number 2426, *Catalpa speciosa.* Structural pruning.
- Accession number 2013-, *Acer rubrum.* Structural pruning.
- Id number 2680, *Acer negundo.* Structural pruning.
- Id number 2433, *Taxodium distichum.* Reduce to upright.
- Accession number 2005-043-A, *Nyssa sylvatica.* Structural pruning.
- Accession number 2008-027-E, *Acer rubrum.* Structural pruning
- Accession number 2015-222-A, *Carpinus caroliniana.* Structural pruning
- Accession number 2008-030-A, *Nyssa sylvatica.* Structural pruning.
- Accession number 2005-043-A, *Nyssa sylvatica.* Structural pruning.
- Accession number 2008-030-B, *Nyssa sylvatica.* Structural pruning.
- Accession number 2008-027-C, *Acer rubrum.* Structural pruning.

In addition to this recommended work, new plants should periodically be planted throughout the area as the Natural Areas Section Leader sees fit. This planting should follow the model laid out above in the "Work Completed" section of this report. Only species found on the Pennsylvania Wetland Native Species List (2001) should be used, and plant location should be left to the discretion of the Natural Lands Section Leader, who should keep in mind mature sizes of the trees, replacement of declining trees, room for seeding in, proximity to black walnut, and aesthetic appeal, as the primary restoration guidelines followed.

CONCLUSION

The Natural Areas of the Morris Arboretum of the University of Pennsylvania are a valuable resource for both education and viewing pleasure. It should be an example of what a native wetlands and woodlands looks like in this region of the country and state. This management plan and partial restoration should be implemented to allow the area to maintain and enhance this purpose.

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ACKNOWLEDGEMENTS

- I would like to thank my supervisor, Andrew Hawkes, for helping me develop this project idea, as well as guiding me through the process by offering advice and helping with the actual work.
- I would like to thank Jason Lubar and Bob Wells in the Urban Forestry Department for teaching me how to use ArcGIS Collector to do tree inventories, and for letting me borrow their iPad whenever I needed it for my project.
- I would like to thank Jess Slade, the Natural Areas Horticulturist, for allowing me to do this project in her area, giving me advice on species selection, and helping me with the planting plan along the way.